

### REMARKS

Reconsideration and allowance of the above-referenced application are respectfully requested. Claims 21-30 are pending. Claims 1-20 are canceled without prejudice or disclaimer. Claims 21-30 have been added. The added claims use notation suggested by the Examiner for (boundary, boundary) indexing cells. The undersigned requests that revision to the specification to reflect this notation be deferred until at least one claim is found allowable. At that point, the undersigned will submit a substitute specification with notation consistent with that acceptable to the Office. No new matter has been added.

### INFORMATION DISCLOSURE STATEMENT

The Office Action recites:

The reason for incorporation by reference practice with respect to applications, which are to issue as U.S. patents, is to provide the public with a patent disclosure that minimizes the public's burden to search for and obtain copies of documents incorporated by reference that may not be readily available. Therefore, the Applicant is requested to furnish the Office with a copy of the following essential materials:

- a) "Spatial Reasoning and Knowledge Representation, Geographic Information Systems in the Government Workshop Proceedings" A. Deepak Publishing (1986) [Pg 5,14]; and
  - b) Antony Treatise, supra at 95 [Pg 8, line 9]
- together with the corresponding Form PTO-1449. Please refer to MPEP § 608.01(p).

It is noted that the "Principles of Data Fusion Automation" reference from the above list is particularly relevant to the claimed invention and was not disclosed with the application. The book has been independently obtained by the Office. A patent by its very nature is affected with a public interest. The public interest is best served, and the most effective patent examination occurs when, at the time an application is being examined, the Office is aware of and evaluates the teachings of all information material to patentability. As per 37 CFR 1.56, each individual associated with the filing and prosecution of a patent application has a duty of candor and good faith in dealing with the Office, which includes a duty to disclose to the Office all information known to that individual to be material to patentability as defined in Chapter 2000 of the MPEP.

An Information Disclosure Statement ("IDS") citing the two references referenced above and the two references are submitted concurrently with this response.

### OBJECTION TO DRAWINGS

The drawings are objected to. Specifically, the Examiner asserts that:

3. Figures 1-3, 4(a) —4 (f), 5, 7, 19, 21 -24, 28, and 30 are objected to under 37 CFR 1.83. A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

3.1 As regards to Figures 1-3, 4(a) —4 (f), 5, and 7 these drawings should be designated by a legend such as — Prior Art — because by applicant's own admission [Pg 8] only that is already known in the art is illustrated. Please refer to MPEP § 608.02(g).

3.2 As regards to Figures 19, 21 -24, 28, and 30, these drawings are objected to because part of the drawing is not completely legible. For example, the upper left corner of Figure 19 contains characters after the phase 'Intersection products outlined in gray; union. . . 'that are assumed to recite in 'black'.

Replacement drawings are submitted concurrently with this response. The replacement drawings address the objections recited above. Specifically, a "(Prior Art)" legend has been added to Figures 1-3, 4(a)-4(f), 5 and 7 and more legible figures are submitted as replacement drawings for Figures 1-30. Please note that in Figure 4 a parenthesis was added to the "(4", thus it is now "(4)". Hence, the undersigned representative respectfully requests that these objections to the drawings be withdrawn.

#### OBJECTION TO THE SPECIFICATION

The specification is objected to for the following reasons:

On page 15 at line 3, the sentence ". . . the position of entry and exit of each of each..." appears to be grammatically incorrect. This sentence appears to contain an extra 'of each'. Appropriate correction is required.

5. The attempt to incorporate subject matter into this application by referencing to the following publications:

- "Principles of Data Fusion Automation" (Artech House 1995) by R. Antony [Pg 8, line 2];
- "Spatial Reasoning and Knowledge Representation, Geographic Information Systems/n the Government Workshop Proceedings" A. Deepak Publishing (1986) [Pg 5,14]; and
- Antony Treatise, supra at 95 [Pg 8, line 9]

is improper because by Applicant's own admission [Pgs 8, 10, and 13] the information contained in these references is deemed essential matter.

The undersigned representative thanks the Examiner for the correction to the typographical error in the first paragraph on page 15 of the specification. An amendment to the specification corrects this typographical error.

Regarding an “attempt to incorporate subject matter into this application by referencing” the three publications lists above, the references are used to illustrate that Class 1 and Class 2 interactions as described in the background of the specification are known in the art. The present application is directed to Class 3 interactions which are not disclosed in such references. The material recited in the identified references is not essential matter to practice the present invention nor is the material being incorporated by reference into this patent application. Thus, the undersigned representative respectfully requests that these objections to the specification be withdrawn.

e present application

#### REJECTION OF CLAIMS 1-20 UNDER 35 U.S.C. §101

Claims 1-20 stand rejected under 35 U.S.C. §101. Specifically, the Examiner asserts that:

Claims 1 - 20 are rejected under 35 U.S.C. 101 because the language of the claims raises a question as to whether the claims are directed merely to an abstract idea that is not tied to a technological art, environment or machine which would result in a practical application producing a concrete, useful, and tangible result to form the basis of statutory subject matter under 35 U.S.C. 101. It is noted that Applicant alleges that the present invention is an improvement over existing algorithms [Pg 35, third full paragraph of specification].

This rejection is moot in view of the cancellation of claims 1-20. Thus, the undersigned representative respectfully requests that the rejection of claims 1-20 under 35 U.S.C. §101 be withdrawn.

Regarding the new claims submitted in this response, as recited on page 1 of the specification, “The present invention relates to Boolean set operations on data sets and, more particularly, to an improved method and software process for Boolean set interaction and set union operations among polygon-represented data sets using a digital computer.” (emphasis added). Thus, reading the claims in view of the entire disclosure, the claims are directed to a method/algorithm that operates on a digital computer, therefore the claims are directed to a machine that produces a concrete, useful, and tangible result that meets the basis of 35 U.S.C. §101.

#### REJECTION OF CLAIMS 1-20 UNDER 35 U.S.C. §112, FIRST PARAGRAPH

Claims 1-20 stand rejected under 35 U.S.C. §112, first paragraph. Specifically, the Examiner asserts that:

Claims 1 - 20 are rejected under 35 U.S.C. 112, first paragraph, as based on a disclosure which is not enabling. For claim 6 recites calculating an overall vector-based set operation by performing a set operation separately on the interior x interior and boundary x interior indexing and combining the results with the boundary x boundary indexing cell product. Therefore, the interior x interior indexing cells set operation and the boundary x interior indexing cells set operation generation process is essential to the practice of the invention, but not included in the claims is not enabled by the disclosure. See *In re Mayhew*, 527 F.2d 1229, 188 USPQ 356 (CCPA 1976). Applicant discloses [Pg 8 of specification] that set operation generation is treated as a three-stage process involving three canonical form classes (Class 1: interaction between two interior cells, Class 2: interaction between a boundary and an interior cell, and Class 3: interaction between two boundary cells). Applicant admits that the appropriate methods for generating the products from Class 1 and Class 2 are described in the 'Antony treatise, supra at 95' reference and that the instant application focuses on Class 3

This rejection is moot in view of the cancellation of claims 1-20. Thus, the undersigned representative respectfully requests that the rejection of claims 1-20 under 35 U.S.C. §112, first paragraph be withdrawn.

#### REJECTION OF CLAIMS 1-20 UNDER 35 U.S.C. §112, SECOND PARAGRAPH

Claims 1-20 stand rejected under 35 U.S.C. §112, second paragraph. Specifically, the Examiner asserts that:

7.2.1 Claims 1-6, 9-19 are rejected under U.S.C. 112, second paragraph, for the following reason: the claims recite the phrases 'boundary x boundary' and/or 'interior x interior' and fails to indicate the meaning of the 'x' character. This character could have different connotations such as matrix operator, cross multiplier, etc.. Claims 7, 8 and 20 depend on one of the rejected claims and therefore are also rejected. Applicant is required to amend accordingly or take other appropriate steps to correct these deficiencies.

7.2.2 Claims 1-8 and 13-20 are rejected under 35 U.S.C. 112, second paragraph, as being incomplete for omitting essential steps, such omission amounting to a gap between the steps. See MPEP § 2172.01. The preamble of claims 1, 13 and 17 recite a method for computing Boolean set operations but the claims fail to recite the step pertaining to computing Boolean set operations. Claims 2-8, 14-16, and 18-20 depend on one of the rejected claims and therefore are also rejected. Applicant is required to amend accordingly or take other appropriate steps to correct these deficiencies.

7.2.3 Claims 9-12 are rejected under 35 U.S.C. 112, second paragraph, for the following reason: the term “optimal” in line I of claim 9 is a relative term, which renders the claim indefinite. The term “optimal” is not defined by the claim, the specification does not provide a standard for ascertaining the requisite degree, and one of ordinary skill in the art would not be reasonably apprised of the scope of the invention. Claims 10 -12 depend on claim 9 and therefore are also rejected. Applicant is required to amend accordingly or take other appropriate steps to correct these deficiencies.

This rejection is moot in view of the cancellation of claims 1-20. Thus, the undersigned representative respectfully requests that the rejection of claims 1-20 under 35 U.S.C. §112, second paragraph be withdrawn.

#### CLAIM INTERPRETATION

The Examiner recites that claims 1, 13, and 17 appear to be Jepson-type structure. Specifically, the Examiner recites:

8. The claims 1, 13, and 17 appear to be in a Jepson-type structure in so far as:
- a) Applicant have not invented computing Boolean set operations on two regions defined by quadtree-indexed vector representations of region boundary tuples,
  - b) the recitation occurs in the preamble, and
  - c) Applicant has admitted [Pg 8 of specification] that the categorical approach for analysis set operations was developed and partially available more than one year prior to the priority date of the instant application.

For example, claim 1 [line 2] recites: “A method for computing Boolean set operations on two regions defined by quadtree-indexed vector representations of region boundary tuples, comprising ..

It is impliedly admitted that a method for computing Boolean set operations on the regions defined by quadtree-indexed vector representations of region boundary tuples is considered to be old in the art. Furthermore, by Applicant’s own admission [Pg 13, paragraph 3] two of the steps are already known in the art. In re Ehrreich, 590 F.2d 902, 909-910 200 USPQ 504, 510 (CCPA 1979) (emphasis in original) (citations omitted). See also Sjolund v. Musland, 847 F.2d 1573, 1577, 6 USPQ2d 2020, 2023 (Fed. Cir. 1988); Pentec, Inc. v. Graphic Controls Corp., 776 F.2d 309, 315, 227 USPQ 766, 770 (Fed. Cir.1985); and Reading & Bates Construction Co. v. Baker Energy Resources Corp., 748 F.2d 645, 650, 223 USPQ 1168, 1172 (Fed. Cir. 1984). Claims must be read in light of the specification. Where the specification confirms that another

before applicants' invention invented the subject matter of the preamble, the preamble is treated as prior art.

Given that Jepson claims are a type or class of claims and that claims can be written in various formats, the undersigned representative is unsure of the Examiner's argument. Please note that the undersigned representative admits that Class 1 and Class 2 interactions as described in the background of the specification are known in the art, but that the present application is directed to Class 3 interactions which was not disclosed prior to one year of filing the present application. Nevertheless, the Examiner's claim interpretation of claims 1-20 is moot in view of the cancellation of claims 1-20.

#### REJECTION OF CLAIMS 1-20 UNDER 35 U.S.C. §102(b)

Claims 1-20 stand rejected under 35 U.S.C. §102(b) as being anticipated by a printed publication by Richard T. Antony ("Antony"). Specifically, the Examiner asserts that:

Claims 1-20 are rejected under 35 U.S.C. 102(b) as being clearly anticipated by a printed publication by Richard T. Antony titled "Principles of Data Fusion Automation" hereafter referred to as Antony. Claims 1 —20 are drawn to a method for computing Boolean set operations on two regions defined by quadtreeindexed vector representation comprising the steps of:

- o classifying quadtree indexing cells for each region as either interior indexing cells or boundary indexing cells;
- o categorizing quadtree indexing cells that interact between the two regions as interior x interior, boundary x interior, or boundary x boundary;
- o defining pseudo points for each boundary x boundary indexing cells;
- o categorizing each Boundary x Boundary indexing cell based on a relationship of said pseudo points, and selecting one of the two regions to be a starting region based on the categorization;
- o calculating a set operation by forming a list of tuples in each Boundary x Boundary indexing cell encountered while tracing the starting region until it intersects with the other region and then accumulating tuples encountered while tracing the other region.

The Antony reference teaches [Chapters 8, section 8.4.4, first paragraph] a method, consisting of a quadtree-based spatial indexed vector-based representation that supports straightforward search, association, and set operations among region features, and comprising the steps of:

- o implementing a hybrid region representation that classifies quadtree indexing nodes (cells) for a region as either interior or boundary;

- o generating (categorizing) quadtree indexing nodes (cells) that interact between two regions [Pg 271, Section 9.2.1] as three classes of intersection products (x):
  - 1) region 1 interior nodes x region 2 interior nodes (interior x interior),
  - 2) region 1 boundary nodes x region 2 interior nodes (boundary x interior), and
  - 3) region 1 boundary nodes x region 2 boundary nodes (boundary x boundary);
- o defining (pseudo) points for each boundary x boundary indexing node (cell) [Pg 253, Hybrid Region Representation];
- o categorizing each exterior boundary (Boundary x Boundary) indexing node (cell) based on a relationship of said pseudo points, and selecting one of the two regions to be a starting region based on the categorization [Pg 253, Hybrid Region Representation];
- o pre-testing that the two regions interact by some degree to ensure that the vector-based set operation is not a null solution [Pg 239, Section Areal-Based Boolean Set Operations]; and
- o calculating a set operation by forming a list of tuples in each Boundary x Boundary indexing nodes encountered while tracing the starting region until it intersects with the other region and then accumulating tuples encountered while tracing the other region [Pg 253, Hybrid Region Representation].

This rejection is moot in view of the cancellation of claims 1-20. Thus, the undersigned representative respectfully requests that the rejection of claims 1-20 under 35 U.S.C. §102(b) be withdrawn.

REJECTION OF CLAIMS 1-20 UNDER 35 U.S.C. §103(a)

Claims 1-20 stand rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 5,649,084 to Ernst ("Ernst") in view of U.S. Patent No. 5,818,460 to Covey *et al.* ("Covey") in view of Antony and in further view of Applicant's own admission. Specifically, the Examiner asserts:

10.1 Claims 1 -20 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 5,649,084 issued to Peter Ernst, hereafter referred to as Ernst in view of U.S. Patent No. 5,818,460 issued to Covey et al., hereafter referred to as Covey in view of a printed publication by Richard Antony (applicant) titled "Principle of Data Fusion Automation" hereafter referred to as Antony, in further view of Applicant's own admission.

10.1.1 The claims are drawn to a method for computing Boolean set operations on two regions defined by quadtree-indexed vector representation comprising the steps of:

- o classifying quadtree indexing cells for each region as either interior indexing cells or boundary indexing cells;
- o pre-testing that two regions interact by some degree to ensure that the vector-based set operation is not a null solution;
- o categorizing quadtree indexing cells that interact between the two regions as interior x interior, boundary x interior, or boundary x boundary;
- o defining pseudo points for each boundary x boundary indexing cells;
- o categorizing each Boundary x Boundary indexing cell based on a relationship of said pseudo points, and selecting one of the two regions to be a starting region based on the categorization;
- o calculating a set operation by forming a list of tuples in each Boundary x Boundary indexing cell encountered while tracing the starting region until it intersects with the other region and then accumulating tuples encountered while tracing the other region.

Ernst teaches [Fig ha & Fig lib and accompanied text] a method for performing Boolean operations on geometric objects comprising the steps of:

- o identifying areas of each geometric object as surface (interior) and curve (boundary);
- o checking if any intersection tracks between two surfaces (regions) exist to ensure that intersection of the two regions is not null;
- o defining surface/surface intersections (interior x interior), curve/surface intersections (boundary x interior) or curve/curve intersections (boundary x boundary) between two surfaces (regions);
- o defining relocated intersection points (pseudo points) for each curve/curve (boundary x boundary) intersection;
- o categorizing curve/curve (boundary x boundary) intersection based on the ordering (relationship) of relocated intersection (pseudo) points;
- o calculating intersection tracks (set operation) ordered in increasing parameter order (tuple points) to complete intersection tracks; and
- o performing a set operation by forming point clusters (tuple) based on curve/curve intersection points.

Ernst does not expressly teach the use of quadtree-indexed vector representation to perform Boolean set operations on the two regions or completing a Boolean set operation by collecting tuple points along a starting region boundary until it intersects the other region and then accumulating tuple points along the other region boundary and repeating the process until the respective boundary x boundary cells have been traversed.

Covey teaches [Col 1, lines 46-62] a method for performing a polygon set operation on two or more polygons (regions) comprising determining a trace



direction based on the set operation and all intersection points between the regions; selecting an initial intersection point between the two polygons (regions); tracing (accumulating tuple points) the perimeter (boundary) of the selected region;

switching between the perimeter as additional intersection points are reached during the tracing; and finishing the process when the original intersection point is reached during the tracing. Covey also teaches [Col 2, lines 43-45] that this method allows for simpler data structures while eliminating undesirable degenerate edges produced by other methods.

Antony teaches [Chapter 8, section 8.3] the use of quadtree data structure to perform Boolean set operations on two regions. Antony further teaches [section 8.3.3] important properties of using quadtree representation such as:

relatively compact representation of 2-dimensional regions, efficient set operation support, and simple transformation, scaling and rotation operations handling.

It would have been obvious to one of ordinary skills in the art, at the time of the invention to implement the method, for computing Boolean set operations on two regions, as taught by Ernst using a quadtree data structure, as taught by Antony, in the fashion taught by Covey to obtain a relatively compact representation of two-dimensional regions and that facilitates efficient set operations while eliminating undesirable edge degeneration.

Finally, it is noted that Applicant has admitted [Pg 8 of specification] that the categorical approach for analysis set operations was developed and partially available more than one year prior to the priority date of the instant application and have admitted that a method for computing Boolean set operations on the regions defined by quadtree-indexed vector representations of region boundary tuples is considered to be old in the art.

As per calculating an overall vector-based set operation by performing a set operation (union and intersection) separately on the interior x interior and boundary x interior cells, and combining the results with the boundary x boundary cell product.

Ernst teaches [steps 61-80 of Fig 11a – 11b and accompanied text] performing a set operation like UNITE, SUBTRACT, or INTERSECT by identifying intersection points between: the surface (interior) of face 1 (region 1) and the surface (interior) of face2 (region 2), the edge (boundary) of face 1 (region 1) and the surface (interior) of face2, the edge (boundary) of face2 (region 2) and the surface (interior) of face 1, and the boundary curve of face 1 and the boundary curve of face 2.

Ernst does not expressly teach calculating an overall vector-based set operation by combining (concatenating) the individual products.

Convey teaches [Fig. 5A and accompanied text] tracing (combining) all intersection points.

Antony teaches [Chapter 9, section 9] that the efficiency of the set operation evaluation process can be significantly affected by clause evaluation order and that based on this observation, intersections should begin with the smallest sized sets. Antony further teaches an overall vector-based set operation

that combines (concatenates) the individual products starting with the smallest size sets products (interior x interior, boundary x interior) and ending with the largest size sets products (boundary x boundary).

Therefore, it would have been obvious to one of ordinary skills in the art, at the time of the invention, to perform set operation by first identifying all intersection points, as taught by Ernst and combining (concatenating) all intersection points, as taught by Covey starting with the smallest size sets and ending with the largest size set products as taught by Antony in order to improve the efficiency of the set operation.

This rejection is moot in view of the cancellation of claims 1-20. Thus, the undersigned representative respectfully requests that the rejection of claims 1-20 under 35 U.S.C. §103(a) be withdrawn.

### CONCLUSION


The foregoing is submitted as a full and complete Response to the non-final Office Action mailed April 29, 2004, and early and favorable consideration of the claims is requested. If the Examiner believes any informalities remain in the application which may be corrected by Examiner's Amendment, or if there are any other issues which may be resolved by telephone interview, a telephone call to the undersigned attorney at (202)508-5843 is respectfully solicited.

Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account 50-1458, and please credit any excess fees to such deposit account.

Respectfully submitted,

Dated: September 15, 2004

KILPATRICK STOCKTON LLP  
607 14<sup>th</sup> Street, Suite 900  
Washington, DC 20005-2018  
Phone 202-508-5883  
Fax 202-585-0041



Michael J. Dimino  
Attorney for Applicant  
Registration No. 44,657